



### **G51 A Comparison of Trauma Associated With Manual and Automated Cardiopulmonary Resuscitation**

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After attending this presentation, attendees will be able to associate certain injury distribution patterns with the type of CPR administered.

This presentation will impact the forensic science community by assisting medical examiners in identifying fracture distribution patterns associated with automated CPR specifically ZOLL AutoPulse® Noninvasive Cardiac Support Pump use. Posterior fractures such as those observed with AutoPulse® CPR are generally noticed in cases of inflicted trauma. By understanding the fracture pattern associated with AutoPulse® CPR, a potentially erroneous interpretation of therapeutic injuries as inflicted can be avoided.

This presentation will detail the results of a retrospective study of the effects of therapeutic intervention with manual cardiopulmonary resuscitation (CPR) compared to the effects of automated mechanical CPR device use. After this presentation, attendees will be able to associate certain injury distribution patterns with the type of CPR administered.

In 2007, Houston TX was selected as a test site for the ZOLL AutoPulse® Noninvasive Cardiac Support Pump. According to ZOLL, the benefits of this device include continuous CPR without fatigue, relief for EMS personnel who are then free to perform other life-saving tasks, and improved blood flow for patients with cardiac distress. The purpose of this study was to identify the trauma associated with AutoPulse® use, particularly how it compares to standard manual CPR. Expanding on previous research that found upper body skin abrasions associated with AutoPulse® use, this study also included the occurrence of hard tissue trauma between the two forms of CPR. It is well established that manual CPR can result in rib and sternal fractures. A comparison of the distribution and frequency of manual CPR fractures to AutoPulse® fractures as well as abrasion occurrence can potentially help rule out erroneous interpretations of inflicted trauma.

Autopsy records from 137 decedents brought to the Harris County Institute of Forensic Science, Houston TX, between the years 2006 to

2009 were analyzed. According to the sample records, manual CPR was performed on 49 individuals (24 males, 25 females) and AutoPulse® CPR was used on 88 individuals (52 males, 36 females). The median age for the manual CPR group was 48 years and the AutoPulse® CPR group was 54 years. The distribution of rib fractures from the anterior, lateral, and posterior compartments as well as sternal fractures and skin abrasions were recorded. Kruskal-Wallis ANOVA comparisons between fractures from the manual CPR group and the AutoPulse® CPR group demonstrated a statistically significant difference ( $p < 0.05$ ) between the number of anterior fractures, lateral fractures, posterior fractures, sternal fractures, and skin abrasions. In manual CPR, anterior fractures had the highest frequency followed by lateral fractures. Posterior fractures were only found in one case, secondary to body placement during manual CPR. In AutoPulse® CPR, anterior fractures had the highest frequency followed by posterior fractures and lastly, lateral fractures. Sternal fractures were found at a higher frequency in the manual CPR group than the AutoPulse® group. Skin abrasions were more common in the AutoPulse® CPR group, located primarily along the anterior chest, lateral chest, and shoulder. In the few cases that abrasions were observed in the manual CPR group, they were located along the sternum.

The results of this study identify the distribution patterns of fractures associated with manual and automated CPR. When rib fractures are found in the anterior or lateral rib cage in association with sternal fractures, they are consistent with manual CPR. When rib fractures are found in the anterior and posterior compartments with chest skin abrasions, they are consistent with automated CPR resulting from AutoPulse® use (and not other types of devices, which were not included in this study). It should be noted that it is mandatory for Houston EMS personnel to initially administer manual CPR before AutoPulse® use and this combination may account for the anterior rib fractures observed in the AutoPulse® CPR group. During manual CPR, chest compressions are administered for an extended period of time, thus causing sternal fractures. The small number of sternal fractures seen in AutoPulse® CPR is likely due to the short duration of manual CPR. The significance of this study to the forensic community is in the importance of identifying fracture distribution patterns associated with AutoPulse® use. Posterior fractures such as those observed with AutoPulse® CPR are generally noticed in cases of inflicted trauma. By understanding the fracture pattern associated with AutoPulse® CPR, medical examiners can avoid a potentially erroneous interpretation of therapeutic injuries as inflicted.

#### **Trauma, Cardiopulmonary Resuscitation, Fractures**